Educator Workshop - "Light, Waves, and Interference”

Interferometry at Radio Frequencies

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INTERFEROMETRY AT RADIO FREQUENCIES

Interferometers at Radio Frequencies

- Sharpen our view of the Universe at long wavelengths
- Produce images of processes that are invisible to the human eye
  - Radio emission from Jupiter's powerful radiation belts
  - Galaxy-size jets from super-massive black holes
  - Interiors of "Stellar Nurseries" - clouds of interstellar gas and dust where new stars are being formed
- Complement studies with Optical and Infrared Interferometry
  - Spatial Resolution is ~100 micro-arcseconds
  - Enables detailed study of high energy processes
- Enable high precision astrometric studies at radio frequencies
  - Cosmic distance measurements
  - Searches for extrasolar planetary systems

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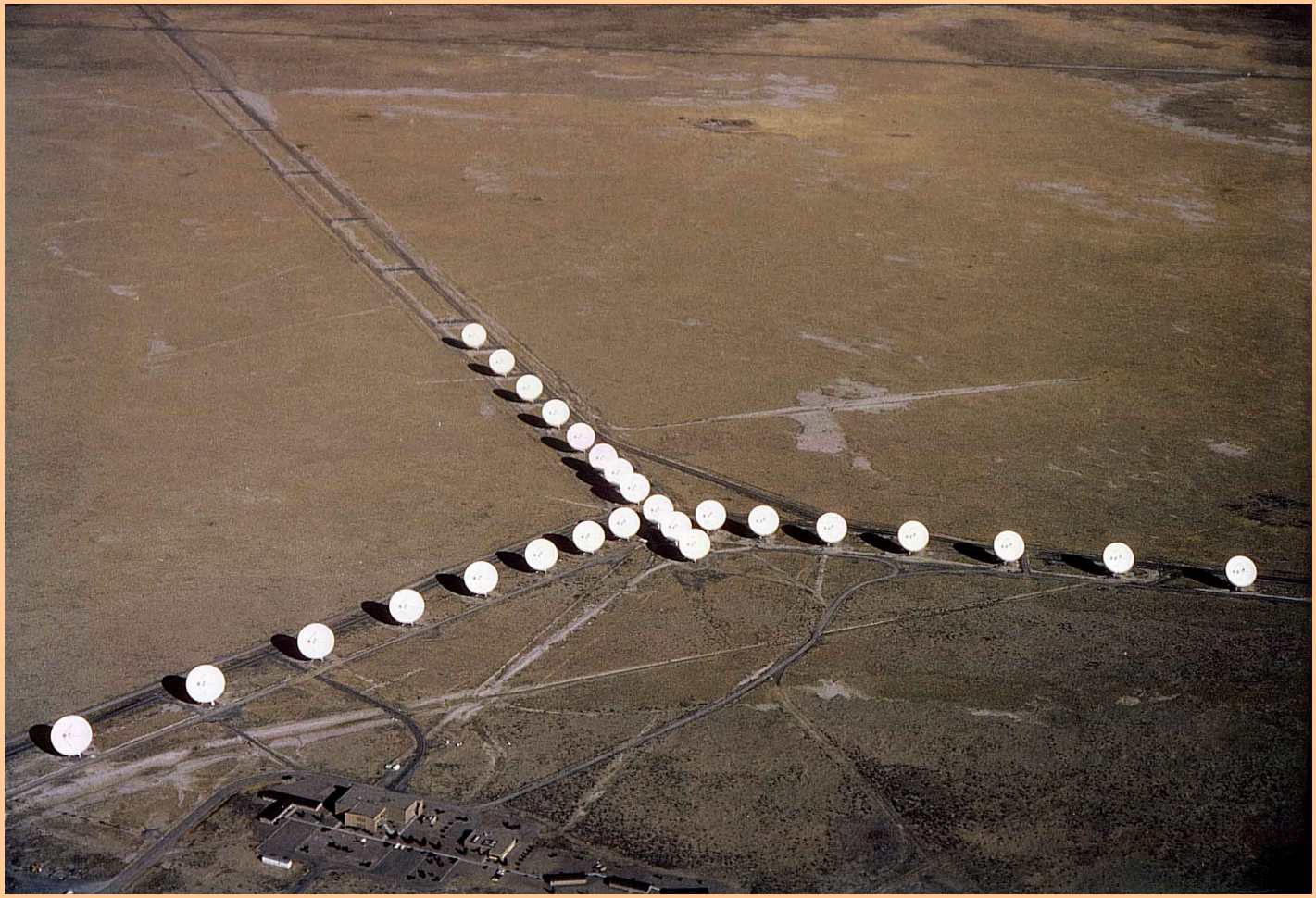
Aerial view of the Very Large Array (VLA), National Radio Astronomy Observatory



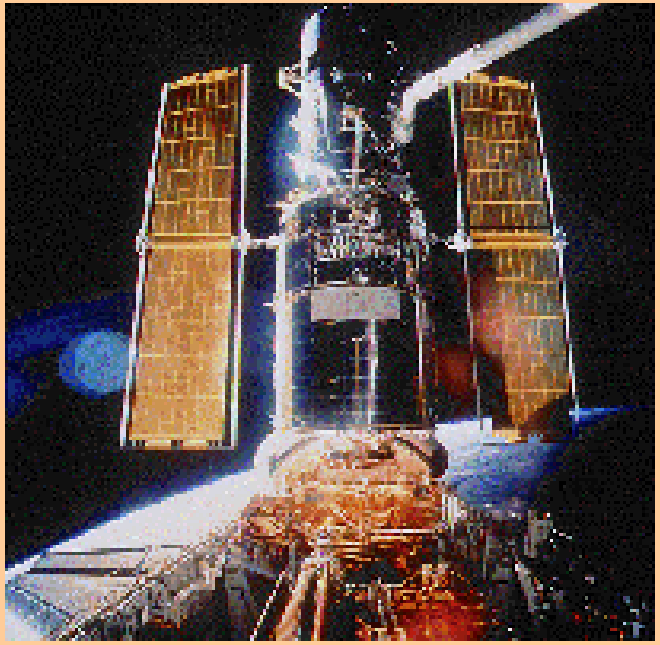
Resolution depends on aperture (and wavelength)

Angular Resolution = 1.22 λ/D

λ = wavelength

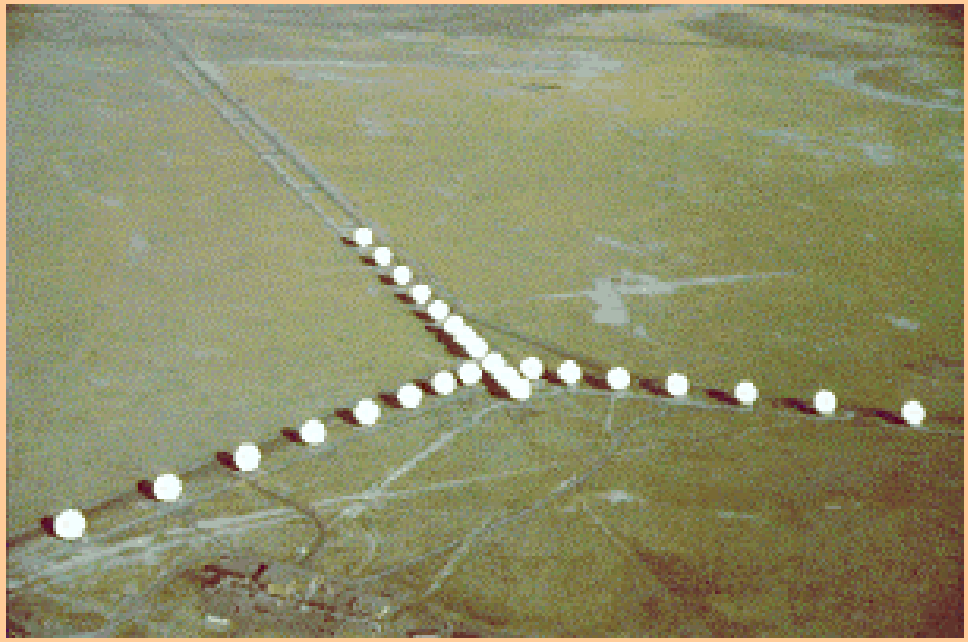
D = aperture

Hubble Space Telescope - visible wavelengths



λ = 5.5 x 10^{-7} m
D = 2.4 m
ΔΘ = 0.058 arc sec

Very Large Array - radio wavelengths



λ =	7 m (Q-Band)	3.6 cm (X-Band)
D =	36 km	36 km
ΔΘ =	0.049 arc sec	0.252 arc sec

Jupiter

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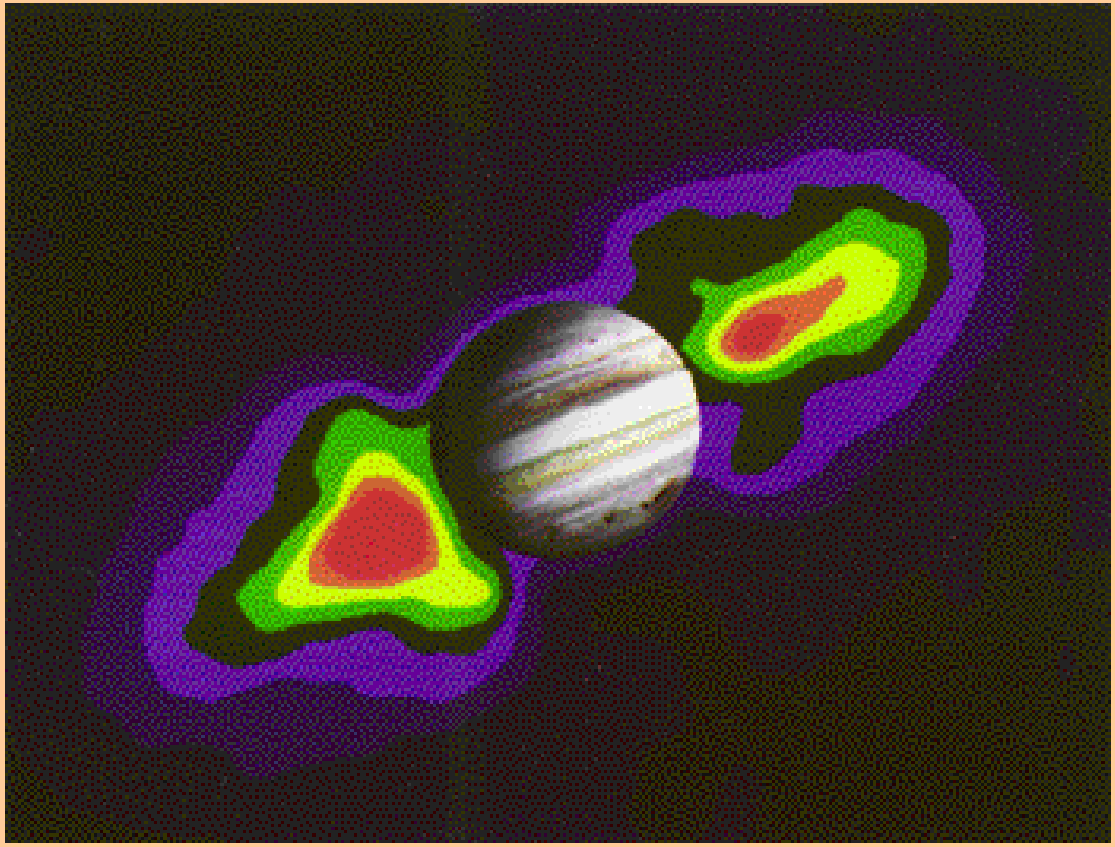
Jupiter image superimposed on a Radio Brightness map of the Radiation Belts



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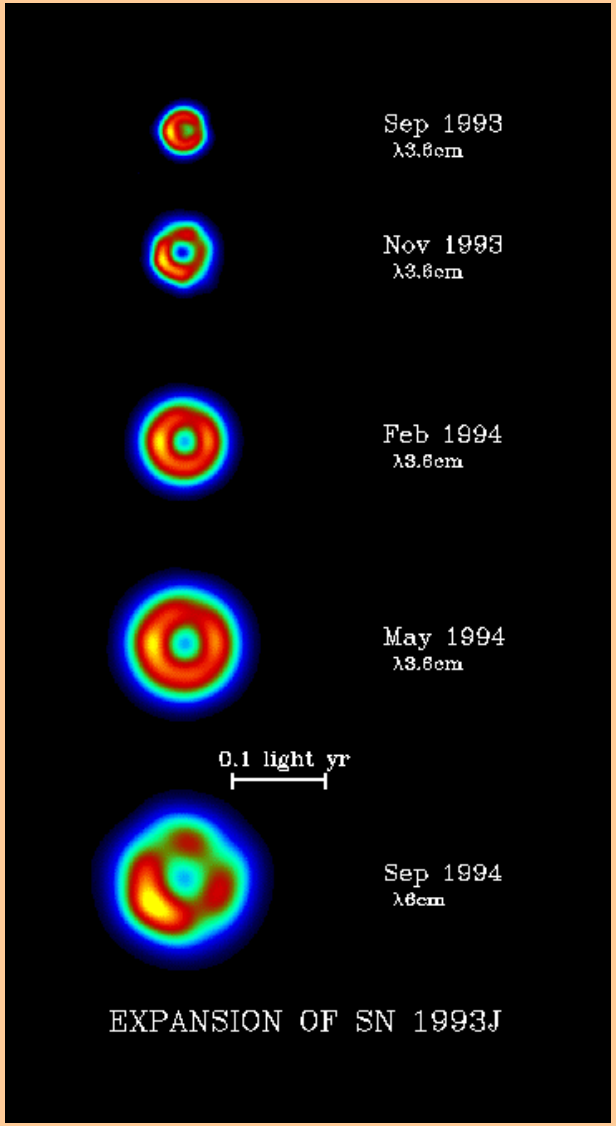
INTERNATIONAL VLBI "CAPTURES" EXPANSION OF SUPER NOVA 1993-J

September 1993 - September 1994

Diameter of radio emission expands ~100 x diameter of solar system



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The Radio Galaxy Centarus-A:
Visible light image and a VLA radio brightness map of the jets

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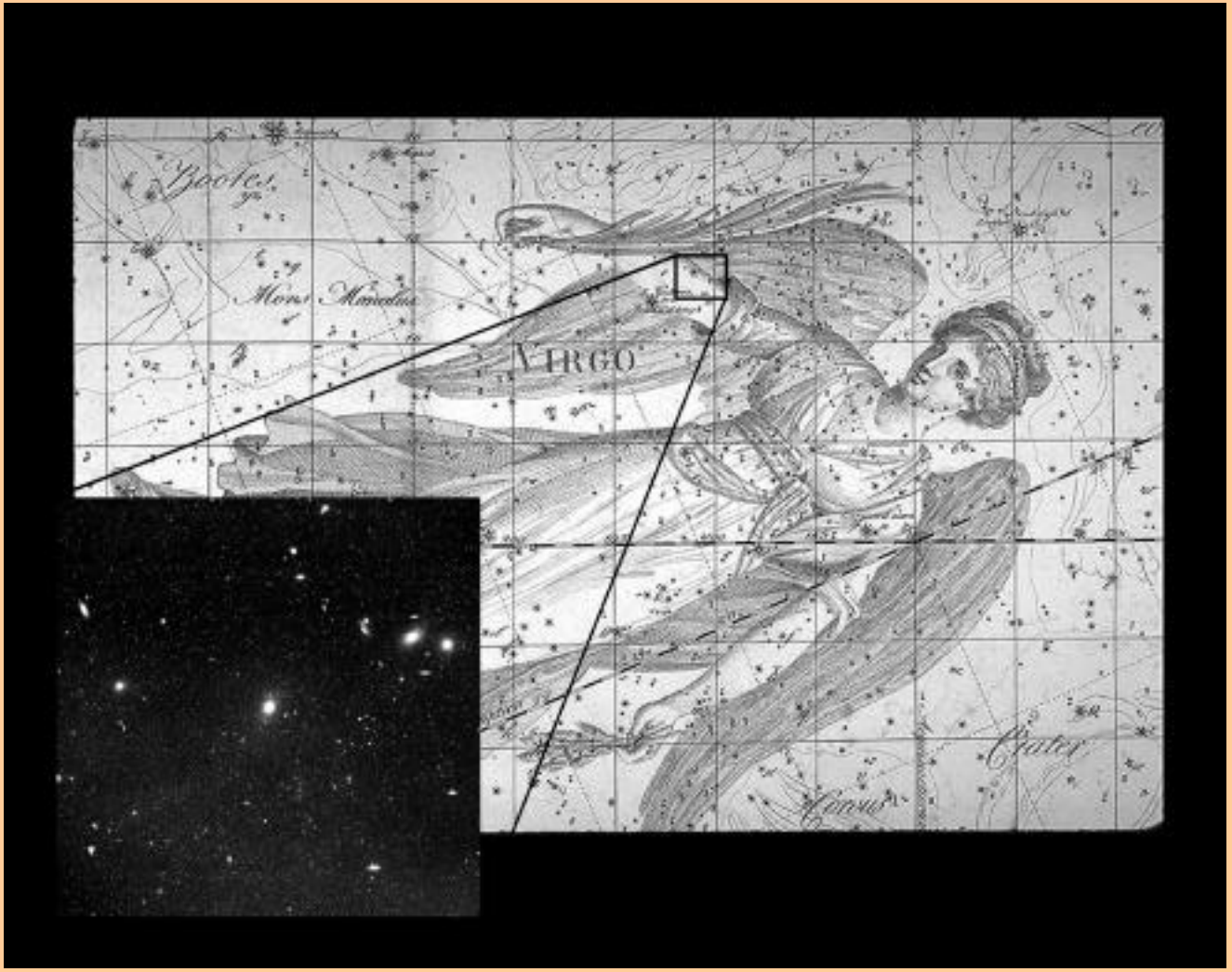
The Radio Galaxy Virgo-A: HST Image



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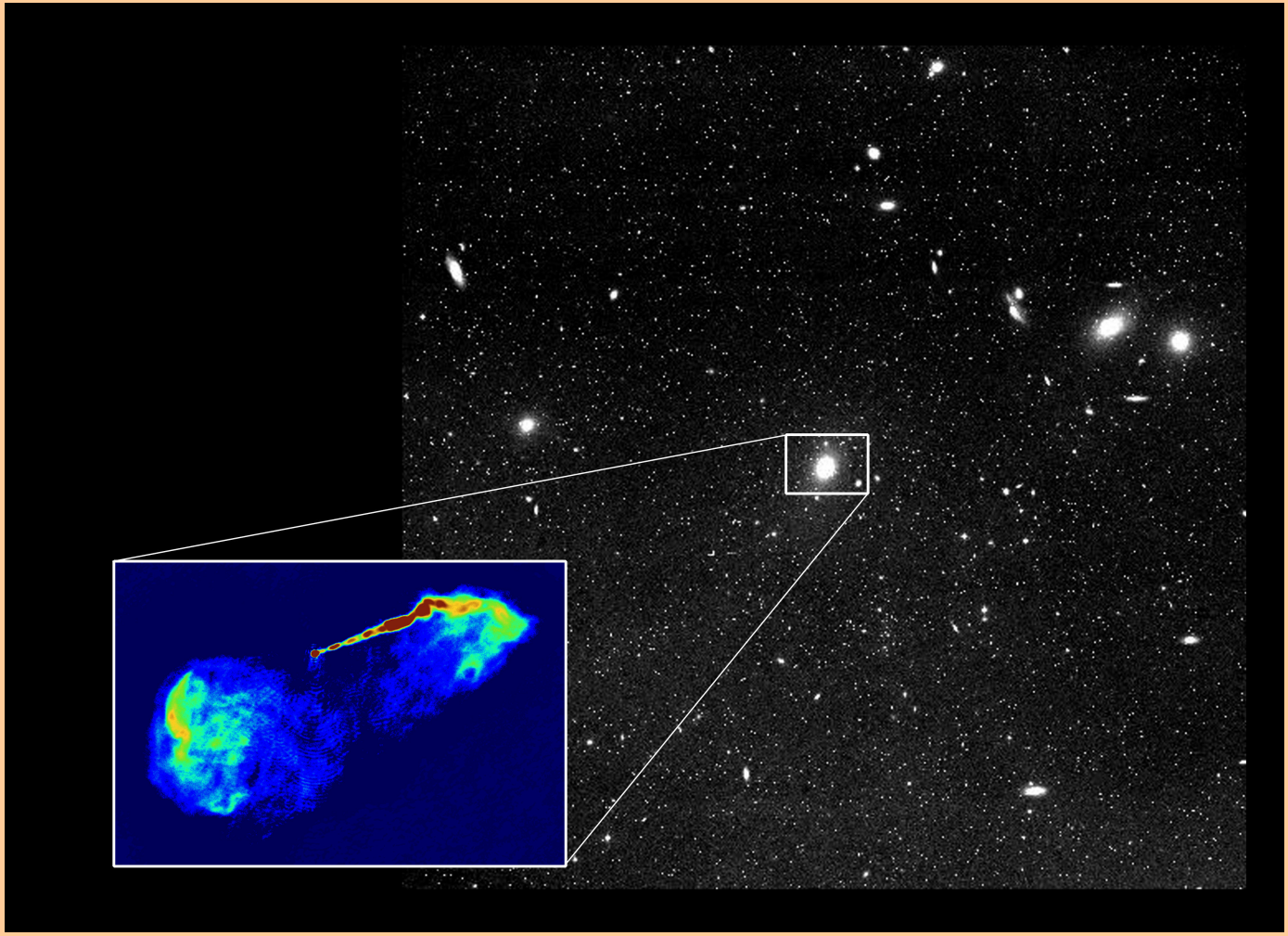
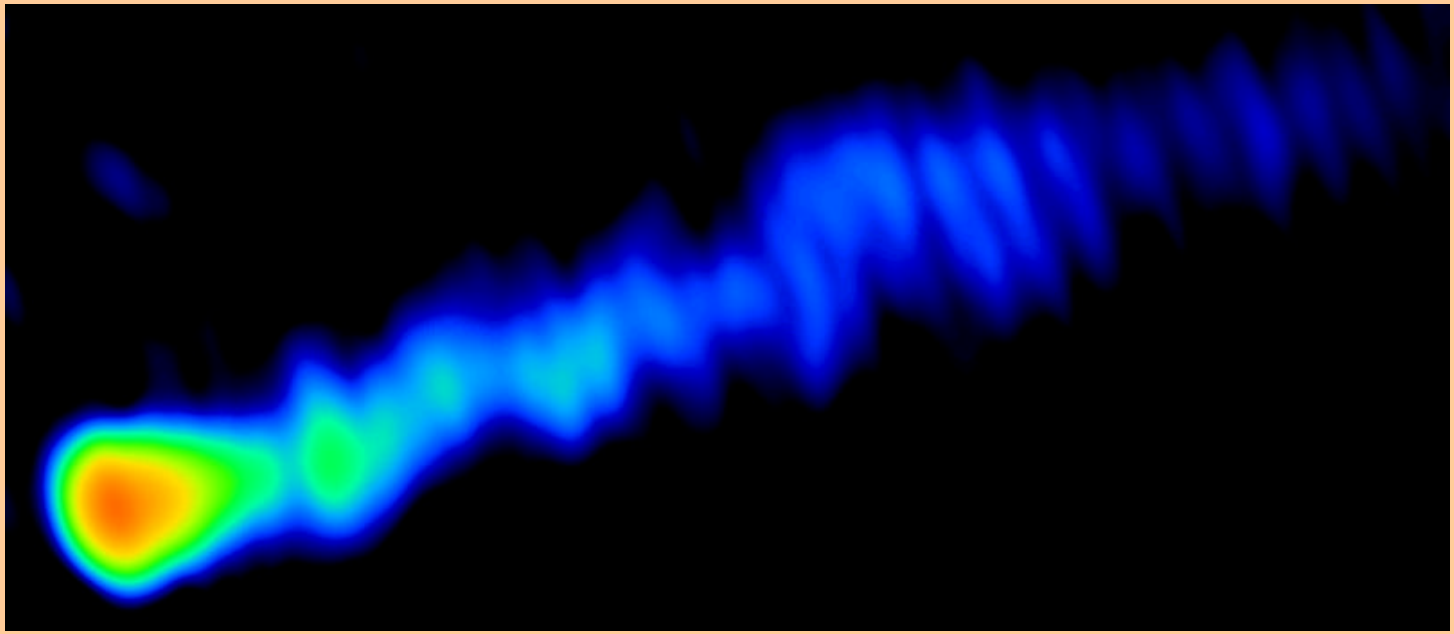
The Radio Galaxy Virgo-A : VLA Image



THE RADIO GALAXY VIRGO-A:
SVLBI Image of the Core and the Inner portion of the Radio Jet



This recent VSOP image was made by Bill Junor (University of New Nexico), John Biretta (Space Telescope Science Institute), Frazer Owen (NRAO), and Mitch Belelman (University of Colorado).

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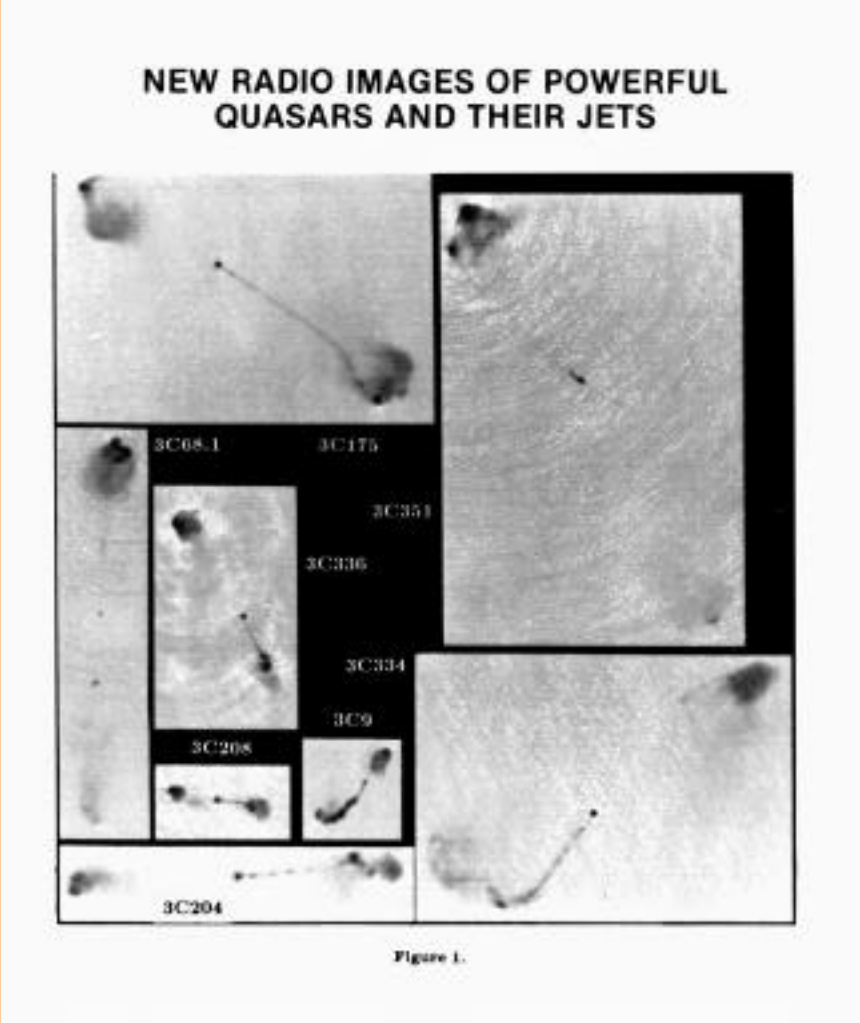
Powerful jets are revealed at radio frequencies

- Evidence of massive black holes
- Condensations in the jets provide a means to study these objects



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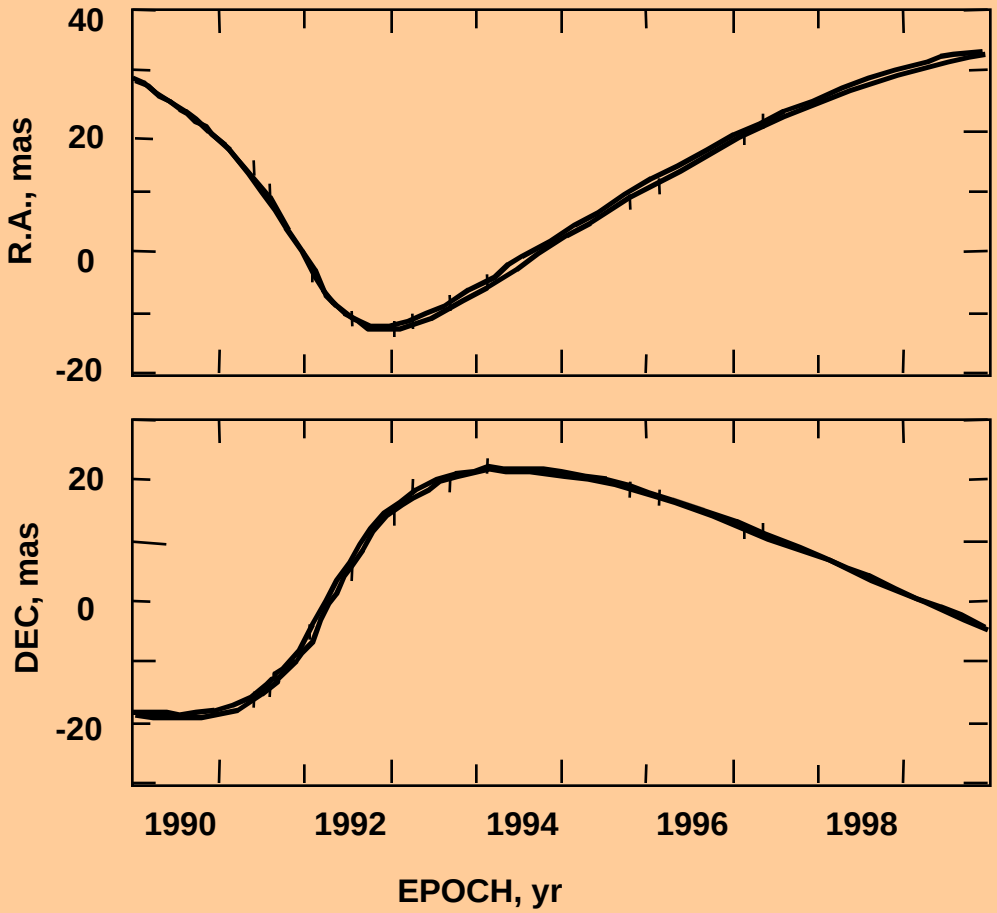
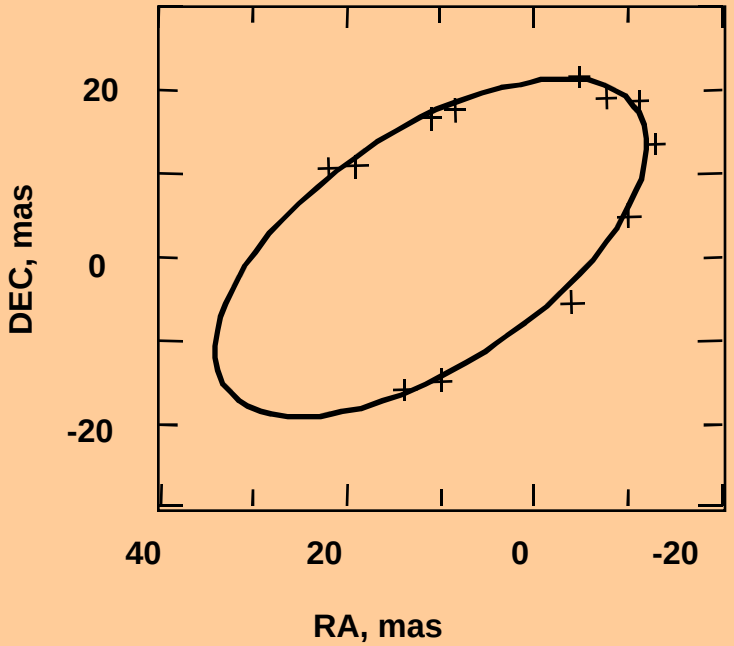
VLBI ASTROMETRY OF RADIO STARS: EVIDENCE OF A LOW-MASS COMPANION (~50 M) ORBITING A NEARBY STAR





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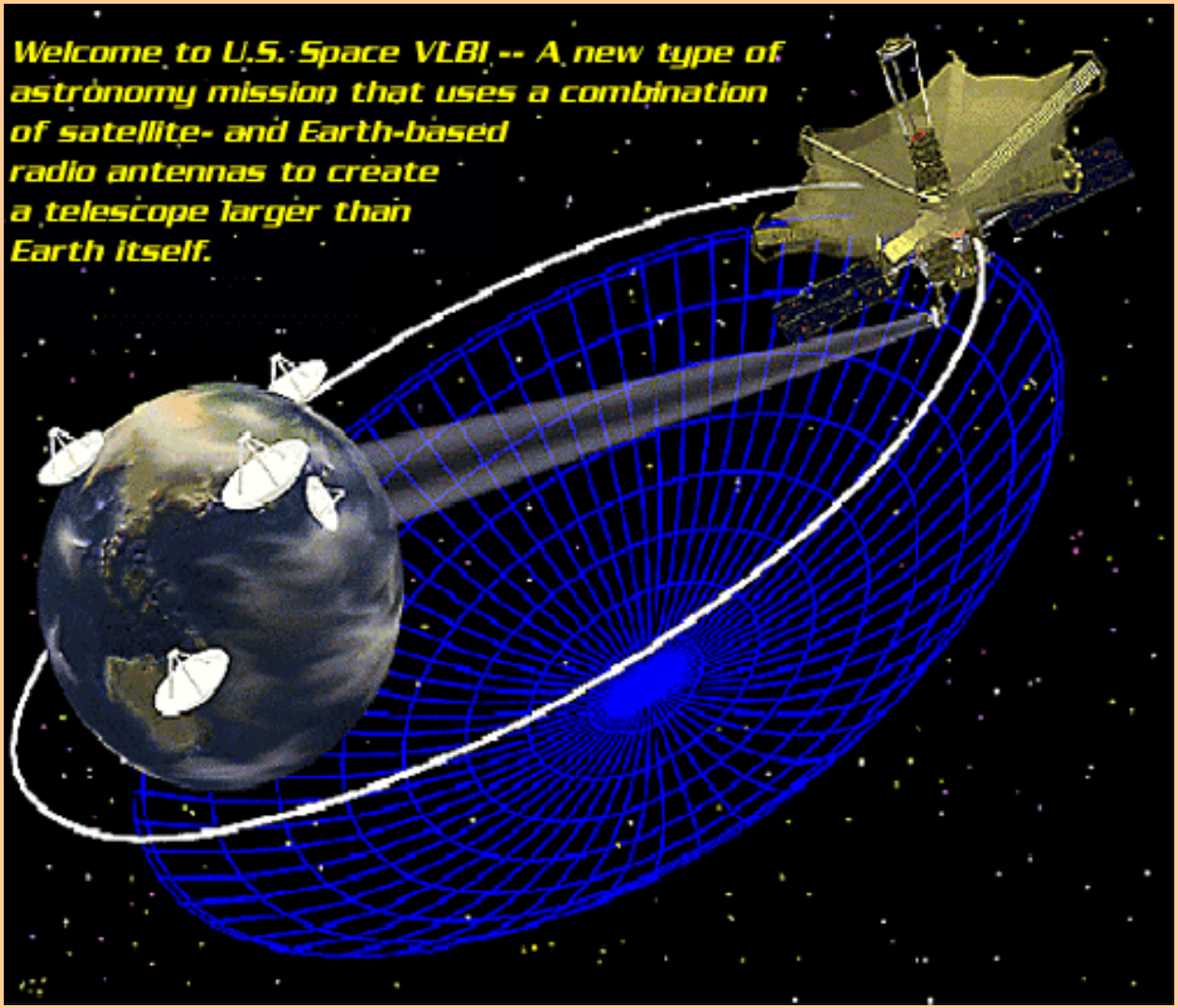

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Astronomical Radio Interferometry between Space and Earth (ARISE)